

WHAT IS CLAIMED IS:

1. A gradient copolymer comprising at least two monomers,
  - a) the first ( $M_1$ ), the homopolymer of which corresponding to a  $Tg_1$  of less than 5  $20^{\circ}\text{C}$ , representing at least 50% by weight of the total weight of the copolymer,
  - b) the second ( $M_2$ ), the homopolymer of which corresponding to a  $Tg_2$  of greater than  $20^{\circ}\text{C}$ , representing at most 50% by weight of the total weight of the copolymer, at least one of the monomers being hydrophilic and representing at least 5% by weight of the total weight of the copolymer,
- 10 said copolymer comprising at least one monomer  $M_i$  such that the probability of encountering  $M_i$  in any standardized position  $x$  situated on the polymer chain is nonzero.
2. The copolymer as claimed in claim 1, wherein  $Tg_1$  is between -150 and  $20^{\circ}\text{C}$ .
- 15 3. The copolymer as claimed in claim 1, having an average masses of between 5000 g/mol and 1 000 000 g/mol and exhibiting a polydispersity index of between 1.1 and 2.5.
- 20 4. The copolymer as claimed in claim 1, wherein the hydrophilic monomer represents at least 10% by weight of the total weight of the copolymer.
5. The copolymer as claimed in claim 1, wherein the hydrophilic monomer is selected from the group consisting of:
  - ethylenic carboxylic acids, acrylic acid, methacrylic acid, itaconic acid, fumaric acid;
  - acrylates and methacrylates of polyethylene glycol or of glycol which are or are not substituted on their end functional group by alkyl, phosphate, phosphonate or sulfonate groups;
  - amides of unsaturated carboxylic acids, acrylamide, methacrylamide and their N-substituted derivatives;
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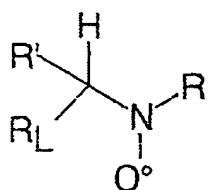
- aminoalkyl acrylates, methacrylates, aminoalkylmethacrylamides,;
- carboxylic anhydrides carrying a vinyl bond, maleic anhydride, fumaric anhydride;
- vinylamides, vinylpyrrolidone, vinylacetamide;
- vinylamines, such as vinylmorpholine, vinylamine; and
- vinylpyridine.

6. The copolymer as claimed in claim 1, wherein the monomer  $M_1$  is selected from the group of monomers consisting of:

- linear or branched C<sub>1</sub>-C<sub>12</sub> alkyl acrylates,
- polyethylene glycol acrylate polyethylene glycol (meth)acrylate,
- dienes, butadiene and isoprene.

7. A process for producing a gradient copolymer comprising polymerizing by solution or bulk controlled radical polymerization, at a temperature of between 10 and 160°C, in the presence of a radical polymerization initiator and of an agent for controlling the polymerization, a mixture of monomers comprising at least two monomers, the first ( $M_1$ ), the homopolymer of which corresponding to a  $Tg_1$  of less than 20°C, representing at least 50% by weight of the total weight of the mixture, the second ( $M_2$ ), the homopolymer of which corresponding to a  $Tg_2$  of greater than 20°C, representing at most 50% by weight of the total weight of the mixture, at least one of the monomers having to be hydrophilic and represent at least 5% by weight of the total weight of the mixture.

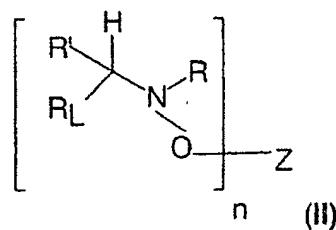
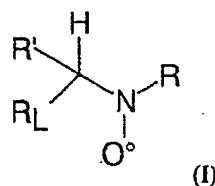
25 8. The process as claimed in claim 7, wherein the agent for controlling the  
polymerization is a nitroxide of general formula:



- where R' and R, which are identical or different and which are optionally connected so as to form a ring, are alkyl groups having between 1 and 40 carbon atoms which are optionally substituted by hydroxyl, alkoxy or amino groups; preferably, R and R' are tert-butyl groups;
- and where R<sub>L</sub> is a monovalent group with a molar mass of greater than 16 g/mol which can be a phosphorus group or an aromatic group.

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9. The process as claimed in claim 7, wherein the polymerization initiator and the control  
10 agent are advantageously replaced by a mixture composed of alkoxyamine  
corresponding to the following general formula (II) and of nitroxide corresponding to  
the general formula (I):



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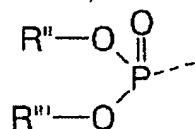
in which:

- n is an integer of less than or equal to 8 and preferably of between 1 and 3,
- Z is a carrying monovalent or polyvalent radical of styryl, acryloyl or methacryloyl type,
- where R' and R, which are identical or different and which are optionally connected so as to form a ring, are alkyl groups having between 1 and 40 carbon atoms which are optionally substituted by hydroxyl, alkoxy or amino groups; preferably, R and R' are tert-butyl groups;

- and where  $R_L$  is a monovalent group with a molar mass of greater than 16 g/mol which can be a phosphorus group or an aromatic group,  
the nitroxide (I) representing from 0 to 20% by weight of the total weight of the mixture.

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10. The process as claimed in claim 8, wherein,  $R_L$  is a phosphonate group of formula:



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- where  $R''$  and  $R'''$ , which are identical or different and which are optionally connected so as to form a ring, are alkyl groups having between 1 and 40 carbon atoms which are optionally substituted by hydroxyl, alkoxy or amino groups; in particular,  $R''$  and  $R'''$  are ethyl groups;  
the nitroxide (I) representing from 0 to 20% by weight of the total weight of the mixture.

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11. A process for the aqueous dissolution, of the gradient copolymer of claim 1 comprising:

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- 1) dissolving the copolymer in a ketone solution, at a level of solid of between 20 and 90%,
- 2) neutralizing the solution obtained in 1, if necessary, by addition of a molar solution either of acid or of base, the acid or base choice being conditioned by the chemical nature of the hydrophilic monomer,
- 25 3) adding water, with vigorous stirring, to the solution obtained in 1 or optionally in 2 in a proportion such that the level of solid obtained is between 1 and 80%; optionally, the water can be replaced by water/alcohol mixtures in proportions ranging from 99/1 to 50/50;
- 4) evaporating the ketone until the desired level of solid is obtained.

12. (canceled)

13. The gradient copolymer of claim 1 comprising a paint, adhesive, glue or cosmetic  
5 formulation.

14. (canceled)

15. (canceled)

10 16. (canceled)

17. The copolymer of claim 1 wherein the second monomer ( $M_2$ ), the homopolymer of  
which corresponding to a  $Tg_2$  of greater than 50°C

15 18. The copolymer as claimed in claim 2, wherein  $Tg_1$  is between -120 and 15°C.

19. The copolymer as claimed in claim 3, exhibiting a polydispersity index of between 1.1  
and 2.

20 20. The process of claim 7 wherein said controlled radical polymerization, occurs at a  
temperature of between 25 and 130°C.